

## **Remarks**

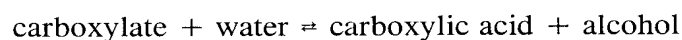
Claims 21 - 40 are pending. Favorable reconsideration is respectfully requested.

Claim 21 has been amended to clarify that the "bottom fraction" referred to in line 13 is a bottom fraction from the reactive distillation column. The claim is neither broadened nor narrowed by this amendment. Support may be found in the specification and all the drawing figures.

The present invention is directed to an improvement in the recovery of carboxylic acid and alcohol from a feed stream of carboxylic acid ester. As one example of such a feed stream, as described on page 1 of the application, the hydrolysis of polyvinylacetate to polyvinyl alcohol typically takes place with methanolic alkali. The byproduct stream from this reaction contains methanol, methyl acetate, and other substances such as acetaldehyde, and generally cannot be used for other purposes. In the inventive process, carboxylic acid esters (carboxylates), including such impure feed stream as described above, can be efficiently hydrolyzed to the corresponding acid and alcohol.

The inventive process requires two reactors and a reactive distillation column one of the reactors being a "prereactor" as that term is generally understood in this art, and as exemplified in WO/01/27062 A2 as prereactor 13 in Figures 1, 2, and 3 of that publication, and prereactors 13a and 13b in Figures 4 and 5.

The function of the prereactor (numeral 3 in subject invention Figures 1 - 5), is to begin the hydrolysis of carboxylate by feeding carboxylate and water into the prereactor, which contains an acidic catalyst, preferably an acidic ion exchange resin. An equilibrium:



is soon reached, after which the product mixture does not change. The product stream, still containing a major amount of carboxylate, is then fed to a reactive distillation column (7). The reactive distillation column removes alcohol, and removes unhydrolyzed carboxylate as an overhead stream at the same time shifting the equilibrium, due to the decreased amount of alcohol and a decreased amount of carboxylic acid which is removed as a bottoms stream.

The overhead, containing large amounts of carboxylate, is routed back to the prereactor 3, where again an equilibrium is established. As can be seen from Figure 1, the inlet streams to prereactor 3 include water (2''), carboxylate (2') and recycled carboxylate 21 (from the reactive distillation overhead).

In Figures 2 - 3,, the recycled carboxylate (21) is not fed to the prereactor 3, but to a second reactor (27).

The second reactor (27) is a required novel feature, and is also termed a "prereactor" by Applicants, but it is not a prereactor in the sense of the prior art. The feed to the second reactor 27 is carboxylate, either fresh, (line 20) or recycled (line 21), and the bottoms from the reactive distillation column 7 or from the distillation column 13, in either case containing largely carboxylic acid and water.

The Office contends that claims 21 - 40 do not meet the unity of invention requirements of the PCT, of which the present application is a national phase application. The basis for this contention is that the two groups of claims (claims 21 - 30, process claims and 31 - 40, apparatus claims) do not share the same or corresponding technical feature, because the claimed process is alleged not to be novel. Applicants respectfully traverse, but confirm the provisional election of claims 21 - 30.

First, there is no issue of novelty (anticipation), as the process claims have not been rejected under 35 U.S.C. § 102(b) for lack of novelty, but rather under 35 U.S.C. § 103(a) for obviousness. However, as can be seen from the discussion below, the claims are

indeed non-obvious, and therefore there is a common technical feature. Thus, the claims should be rejoined. It is noted that the PCT Search Authority found that the unity of invention requirements of the PCT were met. Rejoinder is solicited.

Claims 21 - 30 have been rejected under 35 U.S.C. § 103(a) over Moritz et al. WO 01/27062 ("*Moritz*"). *Moritz* does not disclose, neither does she teach or suggest the claimed invention.

Like the subject invention, *Moritz* is directed to a process for recovering alcohol and carboxylic acid from a carboxylic feed stream. The improvement *Moritz* makes is discussed in the present specification on page 3 of the application (EP 1 220 825 = WO 01/27062), and is directed to an improved conversion rate due to the presence of a prereactor. A further improvement (Figures 4 and 5) is the use of two prereactors, preferably in parallel, so that the inlet streams of carboxylate and water can be shifted between prereactors (13a, 13b) to allow one prereactor to be recharged with catalyst while the process continues to run. In a variant, this feature is dispensed with and the two prereactors are operated in tandem. This arrangement allows greater flexibility in terms of the type and physical form of the catalyst. In any of these embodiments (the last embodiment is described in the *Moritz* specification, but not depicted in any drawing figure), the feeds to the prereactors (53,51) are "fresh" carboxylate. No recycle stream is fed to either reactor. However, *Moritz* does mention this latter possibility in his specification (page 6, lines 29 - 33).

However, what *Moritz* does not disclose, teach, or suggest, is the introduction of carboxylic acid and water into a second reactor. This is a prime feature of the present invention, and is clearly not only not suggested by *Moritz*, but it is counter-intuitive as well. All the hydrolysis reactions in the process, regardless of whether they take place in the prereactor (or two prereactors), a second reactor, or the reactive distillation column, are equilibria. As is well known in carboxylic acid ester synthesis and hydrolysis, or any equilibrium reaction for that matter, increasing the concentration of a product species drives the reaction to the left, i.e. disfavours increases the reactant concentrations to the detriment

or product concentrations. Thus, introducing carboxylic acid (a product) to Applicants' second reactor should decrease the rate of carboxylate (reactant) hydrolysis. This is especially so when considerable alcohol is also present in the carboxylate feed. However, these modifications to the process, modifications neither taught or suggested by *Moritz*, actually make the process not only more efficient, but also increases the allowable throughput.

The *Moritz* publication directs the skilled artisan against recycle of carboxylic acid to any reactor other than the reactive distillation column. In Figures 1 - 5, for example, the bottoms of *Moritz's* reactive distillation column are either removed (and passed to purification distillation (See Figure 2) or recycled (lines 35, 39) to the reactive distillation column. At paragraph [0014], *Moritz* indicates that the reactive distillation column is operated under conditions where the carboxylic acid and water remain in the base of the column, then being delivered to a further separation stage. There is no teaching of any recycle to the single prereactor of Figure 1 nor the twin prereactors of Figures 4 and 5.

Thus, the subject invention cannot be simply viewed as using two prereactors, as disclosed by *Moritz*. The reactors in the subject invention have different feed streams: the prereactor (3) is fed water, fresh carboxylate, and recycled carboxylate; while the second reactor (27) is fed either or both fresh carboxylate or recycle carboxylate, and a water and carboxylic acid stream from either the reactive distillation column or distillation column. The claimed invention is clearly non-obvious over *Moritz*.<sup>1</sup>

It is noted that the major source of metal ion catalyst poisons is the impure carboxylate feed. Most of these poisons accumulate in the prereactor, and if leached therefrom, accumulate in the reactive distillation column. Employing a second reactor in the process of the subject invention does not alleviate this problem as the Examiner suggests, as the circulation of the carboxylic acid/water bottoms into the second reactor will rapidly accumulate catalyst poisons in this second reactor as well, but it will not decrease the catalyst

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<sup>1</sup> The Examiner should note that Dr. Michl, a coinventor of the subject invention, was also a coinventor of the *Moritz* invention, and is very cognizant of its teachings.

poison loading of the prereactor.<sup>2</sup> The catalyst impurities in the reactive distillation column are concentrated in the column itself and the bottoms, not in the overhead (which, prior to condensation, is gaseous).


As stated before, the invention is not concerned merely with the use of a second reactor, but a second reactor with a different feed stream than the first reactor, a feed stream which is not merely carboxylate (ester) and water, as employed by *Moritz*, but carboxylate and a recycle carboxylic acid/water stream. *Moritz* simply does not teach or suggest such a process.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, the Examiner is highly encouraged to telephone Applicants' attorney at the number given below.

The Extension of Time Petition fee of \$120.00 is being transmitted electronically herewith. Please charge any additional fees or credit any overpayments as a result of the filing of this paper to our Deposit Account No. 02-3978.

Respectfully submitted,

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<sup>2</sup> For this reason, as explained in the specification, the prereactor (3), may be replaced by two prereactors such as disclosed by *Moritz*, or a dual chambered prereactor, so that catalyst may be replaced without shutting the continuous process down. The second reactor (27) is still required.